You burn 4.5 moles of octane in your car (

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AI Overview

To find the volume of oxygen needed, we use the stoichiometry of the complete combustion of octane followed by the ideal gas law. **880 liters** (or $\mathbf{8.8 \times 10^2\ L}$) of oxygen gas is required to completely burn 4.5 moles of octane under these conditions.

1. Balance the Chemical Equation

The complete combustion of octane (C_8H_{18}) reacts with oxygen (O_2) to produce carbon dioxide (CO_2) and water vapor (H_2O). The balanced chemical equation is:

$$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$$

2. Determine Moles of Oxygen

According to the balanced equation, 2 moles of octane require 25 moles of O_2. We can set up a ratio to find the moles of O_2 (n) required for 4.5 moles of octane:

$$n = 4.5 \text{ moles } C_8H_{18} \times \frac{25 \text{ moles } O_2}{2 \text{ moles } C_8H_{18}} = 56.25 \text{ moles } O_2$$

3. Convert Temperature to Kelvin

The ideal gas law requires the temperature to be in Kelvin (K). Assuming the given temperature of 63.42 is in degrees Celsius:

$$T = 63.42^\circ\text{C} + 273.15 = 336.57\ \text{K}$$

Ask anything

Where:

- $n = 56.25$ moles
- $R = 0.08206$ L · atm/(mol · K) (ideal gas constant)
- $T = 336.57$ K
- $P = 1.76$ atm

Substituting these values into the equation:

$$V = \frac{(56.25 \text{ moles}) \times (0.08206 \text{ L} \cdot \text{atm}/(\text{mol} \cdot \text{K})) \times (336.57 \text{ K})}{1.76 \text{ atm}}$$

$$V \approx 882.71 \text{ L}$$

Rounding to two significant figures based on the given value of 4.5 moles, the volume is 880 L.

Final Answer ✅

The volume of oxygen gas required to completely combust 4.5 moles of octane at a pressure of 1.76 atm and a temperature of 63.42°C is **880 liters**.

If you would like to explore this problem further, please let me know if you need to calculate the **volume of carbon dioxide produced**, the **total mass of water vapor released**, or if you want to see how the volume changes at **standard temperature and pressure (STP)**.

Hide Code

python

```
# Balanced equation: 2 C8H18 + 25 O2 -> 16 CO2 + 18 H2O
moles_octane = 4.5
moles_O2 = moles_octane * (25 / 2)

P = 1.76 # atm
T_C = 63.42 # Celsius
T_K = T_C + 273.15 # Kelvin
R = 0.08206 # L*atm/(mol*K)
```

```
# PV = nRT -> V = nRT / P
V_O2 = (moles_O2 * R * T_K) / P
print(f"Moles O2: {moles_O2}")
print(f"Volume O2: {V_O2}")
```

Use code with caution.

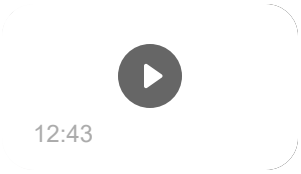
Chemteam.info
https://www.chemteam.info › Volume-Volume(gas)

Stoichiometry: Volume (of gas) Examples

Use PV = nRT to convert **mol** of **oxygen** to **liters of oxygen** at the conditions stated in the problem: (1.00 **atm**) (V) = (50.0 **mol**) (0.08206 **L** solve the problem.

YouTube · Tyler DeWitt
934.3K+ views · 12 years ago

Converting Between Moles and Liters of a Gas at STP



1 mole of gas takes up 22.4 L of volume. We'll learn how to convert back and forth between moles and liters of a gas at STP. 1 mole = 22.4 L at ...

10 key moments in this video

Missing: ~~burn~~ ~~4.5~~ ~~octane~~ ~~car~~ ~~engine.~~ ~~1.76~~ ~~63.42~~

Calculate.co.nz
https://www.calculate.co.nz › combustion-reaction-calc...

Combustion Reaction Calculator

This calculator balances the complete combustion equation for any hydrocarbon or oxygenated fuel with the formula CxHyOz, then works out how much **oxygen** it ... Read more

Chegg
https://www.chegg.com › questions-and-answers

Solved Ideal Gas Law and Stoichiometry Name Use the

Nov 15, 2021 — Ideal Gas Law and Stoichiometry Name Use the following reaction to answer the next few questions: 2 C8H18(1) + 25 O2(g) ----> 16 CO2(g) + 18 H20(g) The ...

1 answer · Top answer: By seeing the reaction - 2 moles of gasoline or octane reacts completely with 2…

Missing: ~~4.5~~ ~~car~~ ~~tank~~ ~~1.76~~ ~~63.42~~

vaia.com
https://www.vaia.com › ... › Chapter 11

Calculate Moles of Octane - Vaia

Approximately 8392.3 **liters** of air are **needed**. This process is **pressure**, **volume**, **temperature**, and amount (**moles**) of **a** gas.

Missing: ~~4.5~~ ~~car~~ ~~tank~~ ~~1.76~~ ~~63.42~~

Filo
https://askfilo.com › ... › Smart Solutions

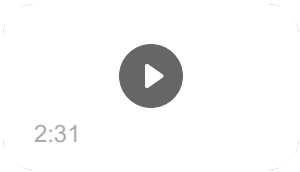
3) Use the following reaction between gasoline and ...

Sep 4, 2025 — **If** 4.00 **moles** of gasoline are **burned**, what **volume** of **oxygen is needed if the pressure** is 0.953 **atm and the temperature** is 35°C? How many **liters** ...

Missing: ~~4.5~~ ~~octane~~ ~~car~~ ~~tank~~ ~~1.76~~ ~~63.42~~

YouTube · Wayne Breslyn (Dr. B.)
5.5K+ views · 2 years ago

Finding the Molar Volume of a Gas given mass and STP



Volume of **O2** gas. V = (1.0 **mol** * 8.314 J/**mol**·K * 273.15 K) 32.0 grams of **O2** gas occupies approximately 22.4 **liters** at STP.

Missing: ~~burn~~ ~~4.5~~ ~~octane~~ ~~engine.~~ ~~tank~~ ~~1.76~~ ~~63.42~~

Quora
30+ answers · 4 years ago

4 liters of octane gasoline weigh 3.19 kg. What volume ...

4 liters of octane gasoline weigh 3.19 kg. What volume of air is required for its complete combustion at S.T.P.?

31 answers · Top answer: To answer this problem, you need to write the balanced equation for the com…

Missing: ~~4.5~~ ~~1.76~~ ~~63.42~~

Course Hero
https://www.coursehero.com › ... › APES › APES 130

Task 5 Ideal Gas Law and Stoichiometry.docx

Apr 8, 2020 — 4.00**mol** C 8 H 18 x 25mol O 2 =50.0 **mol** O 2 1 1 v=50.0x0.0821x308 =1326L O 2 0.953 · n= 1.3x20.0 = 1.20 **mol** O 2 0.0821x263 1.20 **mol** O 2 x 18 **mol** H ... Read more

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